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LABORATORY ULTRASONIC MEASUREMENTS OF SAND-CLAY MIXTURES USED TO RECOVER CLAY CONTENT IN SILTY SANDS

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Imaging the shallow subsurface is a central problem to environmental and engineering applications. Recent technical advances facilitate the collection of high-resolution seismic data for the near surface and laboratory ultrasonic data for unconsolidated materials at low pressures. We collect velocity data for sand-clay mixtures that were measured as a function of pressure using a new laboratory ultrasonic apparatus. The samples were made by combining various amounts of Ottawa sand and Wyoming bentonite to make artificial soils. We show how these laboratory data can be used to constrain lithology interpretation of field data.

To simulate realistic field data, we used the laboratory data with noise comparable to the laboratory measurement uncertainties, and we created an artificial field data set having Vp and Vs velocities for depths to about 20 m. Then these artificial field data were inverted to obtain the clay content in silty sands. To get the clay distribution, the code minimizes the misfit between the synthetic field data (Vp, Vs) pairs in the region of interest and velocities for known clay content as determined by second-order curve fits to the laboratory velocity-pressure data.

In order to show how laboratory data can be used to constrain lithology interpretation, we built models using common shallow subsurface structure found in the environmental and engineering literature. We show for some models that by using (Vp, Vs) data sets, we are able to improve recovery of the clay distribution compared to results obtained using Vp only. In future work we plan to investigate electrical measurements as additional constraints to improve our results. Laboratory data collected to simulate shallow, controlled conditions are very valuable for recovering soil distribution from field data in engineering and environmental studies.

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